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# PROJECT CHECO SOUTHEAST ASIA REPORT

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**PROJECT**

**C**ontemporary  
**H**istorical  
**E**xamination of  
**C**urrent  
**O**perations  
**REPORT**

**AIR TACTICS AGAINST NVN**

**AIR GROUND DEFENSES**

**DECEMBER 1966-1 NOVEMBER 1968 (U)**

**30 AUGUST 1969**

**HQ PACAF**

**Directorate, Tactical Evaluation  
CHECO Division**

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**Prepared by:**

**MAJOR JOHN C. PRATT**

**Project CHECO 7th AF, DOAC**

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## PROJECT CHECO REPORTS

The counterinsurgency and unconventional warfare environment of Southeast Asia has resulted in the employment of USAF airpower to meet a multitude of requirements. The varied applications of airpower have involved the full spectrum of USAF aerospace vehicles, support equipment, and manpower. As a result, there has been an accumulation of operational data and experiences that, as a priority, must be collected, documented, and analyzed as to current and future impact upon USAF policies, concepts, and doctrine.

Fortunately, the value of collecting and documenting our SEA experiences was recognized at an early date. In 1962, Hq USAF directed CINCPACAF to establish an activity that would be primarily responsive to Air Staff requirements and direction, and would provide timely and analytical studies of USAF combat operations in SEA.

Project CHECO, an acronym for Contemporary Historical Examination of Current Operations, was established to meet this Air Staff requirement. Managed by Hq PACAF, with elements at Hq 7AF and 7AF/13AF, Project CHECO provides a scholarly, "on-going" historical examination, documentation, and reporting on USAF policies, concepts, and doctrine in PACOM. This CHECO report is part of the overall documentation and examination which is being accomplished. Along with the other CHECO publications, this is an authentic source for an assessment of the effectiveness of USAF airpower in PACOM.



MILTON B. ADAMS, Major General, USAF  
Chief of Staff

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DEPARTMENT OF THE AIR FORCE  
HEADQUARTERS PACIFIC AIR FORCES  
APO SAN FRANCISCO 96553



REPLY TO  
ATTN OF

DOTEC

30 August 1969

SUBJECT

Project CHECO Report, "Air Tactics Against NVN Air/Ground Defenses,  
Dec 66-1 Nov 68" (U)


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FOR THE COMMANDER IN CHIEF

  
WARREN H. PETERSON, Colonel, USAF  
Chief, CHECO Division  
Directorate, Tactical Evaluation  
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- (10) AFXOSV . . . . . 1
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- (12) AFXOTW . . . . . 1
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(d) DOREA. . . . . 1  
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1. DORF. . . . . 1  
2. DI. . . . . 1  
(b) T9AF(DI). . . . . 1  
(c) USAFSOF(DO). . . . . 1

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(b) 4TFW(DO). . . . . 1  
(c) 23TFW(DOI). . . . . 1  
(d) 27TFW(DOI). . . . . 1  
(e) 33TFW(DOI). . . . . 1  
(f) 64TAW(DOI). . . . . 1  
(g) 67TRW(C). . . . . 1  
(h) 75TRW(DOI). . . . . 1  
(i) 316TAW(DOP). . . . . 1  
(j) 317TAW(EX). . . . . 1  
(k) 363TRW(DOI). . . . . 1  
(l) 464TAW(DOIN). . . . . 1  
(m) 474TFW(TFOX). . . . . 1  
(n) 479TFW(DOF). . . . . 1  
(o) 516TAW(DOPL). . . . . 1  
(p) 441OCCTW(DOTR). . . . . 1  
(q) 451OCCTW(DO16-I). . . . . 1  
(r) 4554CCTW(DOI). . . . . 1

#### (4) TAC CENTERS, SCHOOLS

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(b) USAFTARC(DID). . . . . 2  
(c) USAFTALC(DCRL). . . . . 1  
(d) USAFTFWC(CRCD). . . . . 1

(e) USAFAGOS(DAB-C). . . . . 1

### b. SAC

#### (1) HEADQUARTERS

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(c) DM. . . . . 1  
(d) DI. . . . . 1  
(e) OA. . . . . 1  
(f) HI. . . . . 1

#### (2) AIR FORCES

(a) 2AF(DICS). . . . . 1  
(b) 15AF(DI). . . . . 1

#### (3) AIR DIVISIONS

(a) 3AD(DO). . . . . 3

### c. MAC

#### (1) HEADQUARTERS

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(b) MAOCO. . . . . 1  
(c) MACHO. . . . . 1  
(d) MACOA. . . . . 1

#### (2) AIR FORCES

(a) 21AF(OCXI). . . . . 1  
(b) 22AF(OCXI). . . . . 1

#### (3) WINGS

(a) 61MAWg(OIN). . . . . 1  
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  - (a) ADODC . . . . . 1
  - (b) ADOOP . . . . . 1
  - (c) ADLCC . . . . . 1
- (2) AIR FORCES
  - (a) AF ICELAND(FICAS) . . . 2
- (3) AIR DIVISIONS
  - (a) 25AD(OIN) . . . . . 1
  - (b) 29AD(ODC) . . . . . 1
  - (c) 33AD(OIN) . . . . . 1

## e. ATC

- (1) HEADQUARTERS
  - (a) ATXPP-X . . . . . 1

## f. AFLC

- (1) HEADQUARTERS
  - (a) MCVSS . . . . . 1

## g. AFSC

- (1) HEADQUARTERS
  - (a) SCLAP . . . . . 3
  - (b) SCS-6 . . . . . 1
  - (c) SCGCH . . . . . 2
  - (d) SCTPL . . . . . 1
  - (e) ASD(ASJT) . . . . . 1
  - (f) ESD(ESO) . . . . . 1
  - (g) RADC(EMOEL) . . . . . 2
  - (h) ADTC(ADGT) . . . . . 1

## h. USAFSS

- (1) HEADQUARTERS
  - (a) XR. . . . . 1
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## (2) SUBORDINATE UNITS

- (a) Eur Scty Rgn(OPD-P) . . . 1
- (b) 6940 Scty Wg(OOD) . . . 1

## i. AAC

- (1) HEADQUARTERS
  - (a) ALDOC-A . . . . . 2

## j. USAFSO

- (1) HEADQUARTERS
  - (a) COH . . . . . 1

## k. PACAF

- (1) HEADQUARTERS
  - (a) DP . . . . . 1
  - (b) DI . . . . . 1
  - (c) DPL . . . . . 2
  - (d) CSH . . . . . 1
  - (e) DOTECH . . . . . 5
  - (f) DE . . . . . 1
  - (g) DM . . . . . 1
  - (h) DOTECH . . . . . 1

## (2) AIR FORCES

- (a) 5AF(DOPP) . . . . . 1
- (b) Det 8, ASD(DOASD) . . . 1
- (c) 7AF
  - 1. DO . . . . . 1
  - 2. DIXA . . . . . 1
  - 3. DPL . . . . . 1
  - 4. TACC . . . . . 1
  - 5. DOAC . . . . . 2

- (d) T3AF
  - 1. CSH . . . . . 1
  - 2. DPL . . . . . 1
- (e) 7/13AF(CHECO) . . . . . 1

## (3) AIR DIVISIONS

- (a) 313AD(DOI) . . . . . 1
- (b) 314AD(DOP) . . . . . 2
- (c) 327AD
  - 1. DO . . . . . 1
  - 2. DI . . . . . 1
- (d) 834AD(DO) . . . . . 2



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## (4) WINGS

- (a) 8TFW(DCOA) . . . . . 1
- (b) 12TFW(DCOI) . . . . . 1
- (c) 35TFW(DCOI) . . . . . 1
- (d) 37TFW(DCOI) . . . . . 1
- (e) 56SOW(WHD) . . . . . 1
- (f) 347TFW(DCOOT) . . . . . 1
- (g) 355TFW(DCOC) . . . . . 1
- (h) 366TFW(DCO) . . . . . 1
- (i) 388TFW(DCO) . . . . . 1
- (j) 405TFW(DCOA) . . . . . 1
- (k) 432TRW(DCOI) . . . . . 1
- (l) 460TRW(DCOI) . . . . . 1
- (m) 475TFW(DCO) . . . . . 1
- (n) 1st Test Sq(A) . . . . . 1

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### (1) HEADQUARTERS

- (a) ODC/OA . . . . . 1
- (b) ODC/OTAD . . . . . 1
- (c) OOT . . . . . 1
- (d) XDC . . . . . 1

### (2) AIR FORCES

- (a) 3AF(ODC) . . . . . 2
- (b) 16AF(ODC) . . . . . 2
- (c) 17AF
  - 1. ODC . . . . . 1
  - 2. OI.D. . . . . 1

### (3) WINGS

- (a) 36TFW(DCOID) . . . . . 1
- (b) 50TFW(DCO) . . . . . 1
- (c) 66TRW(DCOIN-T) . . . . . 1
- (d) 81TFW(DCOI) . . . . . 1
- (e) 401TFW(DCOI) . . . . . 1
- (f) 513TAW(OID) . . . . . 1

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## FOREWORD

Recording tactical evolution, this CHECO report depicts varying attempts to suppress the AAA/MIG/SAM threat in North Vietnam. A continuing report, it discusses North Vietnam defenses, the MIG barrier in Route Package areas, and effectiveness of strike forces in accomplishing interdiction.

The initial report on "Air Tactics Against NVN Air/Ground Defenses" provided background data through November 1966. Three previous CHECO reports titled "ROLLING THUNDER" examined air tactics. Detailed studies of systems and tactics mentioned in this report may be found in CHECO publications: "Tactical Electronic Warfare Operations in SEA, 1962-1968," and "Air-to-Air Encounters over NVN, 1 July 1967-31 December 1968."

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# CHARACTERISTICS OF AA WEAPONS IN NORTH VIETNAM

Weapon	Maximum range		Muzzle velocity (ft/sec)	Rate of fire		Elevation tracking rate* (deg/sec)	Elevation limits, lower/upper (deg)	Fire Control
	Horiz. (ft)	Vert. (ft)		Practical (rounds/min/barrel)	Cyclic (rounds/min/barrel)			
Quad 12.7-mm Heavy machine gun, DShK	19,500	14,436	2,821	100	600	25	0/90	Optical AA speed ring)
14.5-mm Heavy machine gun ZPU-2 (twin) & ZPU-4 (quad)	22,950	14,750	3,280	150	600	25	0/90	Optical (reflex)
37-mm AA gun M1939	26,256	10,685	2,886	80	180	25	-5/85	Optical (mechanical computing sight)
57-mm AA gun, ZSU-57-2 (twin) self-propelled	39,360	28,873	3,280	70	120	20	-5/85	Optical (mechanical computing sight)
57-mm AA gun, S-60	39,360	28,873	3,280	70	120	20	-4/87	Optical (mechanical computing) PUAZO-6; FIRE CAN
85-mm AA gun, KS-12	50,850	34,450	2,642	15	20	20	-3/82	PUAZO-6 and WHIFF (SON-4)
100-mm AA gun, KS-19	69,000	50,500	2,952	--	15	20	-3/85	PUAZO-6 and FIRE CAN (SON-9)

\* All guns listed in this table have an azimuthal tracking rate of 30 deg/sec

\*\* With on-carriage fire control

# With off-carriage fire control (PUAZO-6 and/or FIRE CAN)

FIGURE 1

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## CHAPTER I

### THE CONTINUING THREAT - JANUARY-MARCH 1967

Due to the policy of measured escalation, the pilots who flew strike missions into NVN from the end of 1966 until the bombing halt in November 1968 were still opposed by an escalating and increasingly sophisticated array of air and ground defenses. Although estimates of the total number of antiaircraft (AA) weapons varied,\* at the beginning of 1967, the NVN AAA/AW threat alone consisted of between 5,000-7,000 weapons of the types depicted in Figure 1.

Added to this conventional threat was the SA-2 missile system (SAM) whose destructive parameters ranged from about 6-17 NM and from about 1,500-83,000 feet AGL.<sup>1/</sup> A typical SAM site with its FAN SONG radar is shown in Figure 2. Despite the low kill ratio (by the end of 1966, 1,017 firings\*\* had destroyed 39 U.S. aircraft),<sup>2/</sup> missiles from any one of the 152 SAM capable sites served not only to force U.S. aircraft down into the conventional fire envelope, but also caused aircrews to jettison ordnance; their bombing accuracy was also decreased, due to evading SAMs.<sup>3/</sup>

There were also the MIGs, which by December 1966 had shot down nine U.S. aircraft (while losing 25 of their own),<sup>4/</sup> and which still experienced relative

\* ROLLING THUNDER Digest Nr. 4 lists 7,094 occupied positions (guns) for March 1967; Naval Ordnance Laboratory Tech Memo 71-45 notes 5,997 guns in the same month; other sources vary even more.

\*\* MONEVAL Summary, AF Defense Analysis (DAWES), Vol I lists 28 losses to 908 SAMs fired.

# DAWES listed 11 U.S. aircraft lost vs. 23 MIGS.

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immunity from attack except when they chose to engage. Although the North Vietnam Air Order of Battle (AOB) for 15 December 1966 showed only 53 MIG 15/17/21s on station at fields such as Phuc Yen, and Gia Lam, it noted that Communist China had nearly 500 MIGs at its disposal which could readily be transferred to the NVNAF or used in NVNAF/ChiCom AF operations.<sup>5/</sup>

Added to all this was what one THUD pilot called the "Hanoi Habit": even waitresses would run outside and start firing when the sirens sounded, using weapons from 7.62 rifles to the WW II Browning M-2 .50 calibre machine gun.

Most important was the fact that NVN defenses were becoming more refined. On 28 November 1966, for instance, aircraft being vectored to intercept a single MIG suddenly sighted six missiles coming up at them. After successfully evading the SAMs, the U.S. aircraft were informed that four additional MIGs were trailing the first one. Although no MIG engagements occurred on that mission, it became apparent that NVN was successfully integrating its defenses.<sup>6/</sup>

A few days later, in December 1966, the MIGs scored their first success with an air-to-air missile,<sup>7/</sup> while on the ground AAA crews were taking more interest in revetting sites and providing mixed occupancy (4-37-mm and 2-AW, for instance) as protection against flak suppression. They were also building more prepared sites (from April to December 1966, the ratio of occupied versus total prepared positions increased from 1:3 to 1:4),<sup>8/</sup> thus creating mobility and protection at the same time.

Since September 1966, the U.S. had satisfactorily tested the QRC 160 pod, had used EB-66 aircraft to counter SAM and AAA radars in the frequency band of

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FAN SONG Radar (A) and SAM Site (B)  
(Displacement patterns varied at  
nearly all sites in NVN)

FIGURE 2

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2800 MHz to 3200 MHz, and had developed the WILD WEASEL/IRON HAND concept to provide flak/SAM suppression, but overall monthly losses had not yet shown a significant decrease. At the end of 1966, there were only 76 pods available to USAF aircraft.<sup>9/</sup>

Introduction of the pod had caused NVN crews to begin using barrage SAM tactics.<sup>10/</sup> As a result, the largest monthly loss to SAMs occurred during December: eight U.S. aircraft downed from 248 firings.<sup>11/</sup> Additionally, the EB-66s were being forced to orbit farther and farther away as the SAM rings expanded, requiring use of new tactics by WILD WEASEL/IRON HAND flights. On 29 November 1966, a tactics symposium held at Ubon RTAFB, Thailand, recommended that "IRON HAND flights should have the authority to divert strike aircraft to attack an active SAM site" and that "rockets are a very poor munition for IRON HAND."<sup>12/</sup> It was recommended that CBU 24 be used. Approving the ordnance request, 7AFs position on the suggested change in tactics was as follows: "current policy does not permit WILD WEASEL blanket authority to divert strike flights. There is no change anticipated to the policy."<sup>13/</sup>

By the end of 1966, even though one man could say that "the U.S. had now gone one step ahead in the dynamic ECM battle,"<sup>14/</sup> this step had not really been taken; it was merely poised. Despite the new equipment, a few commanders still believed there was only one solution:<sup>15/</sup>

*"Kill the SAM and suppress the AAA. This may not be a quick or especially newsworthy effort; however it would appear to be a better approach for a long term war. With elimination of the SAMs and suppression of AAA, selected*

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*targets will be struck with greater accuracy. This is still a requirement of urgency if fighters are to operate in Route Packages V and VI with impunity."*

At what would turn out to be the midpoint of air operations against NVN, the U.S. continued to send a relatively standardized strike force over prescribed routes at about the same times each day, striking and restriking only Joint Chiefs of Staff (JCS) approved targets. ("In ROLLING THUNDER areas VIA and VIB...only fragged targets were struck and no targets of opportunity were allowed."<sup>16/</sup> Ironically, the tactical fighter pilots found themselves not only performing an essentially strategic role, but also forced by the nature of the NVN defenses to be concerned not primarily with target destruction but with simple self-preservation.

As one report concluded, "the best testimonial to the effectiveness of ROLLING THUNDER is the monumental effort Hanoi is making to stop it."<sup>17/</sup>

With the northeast monsoon hampering operations from January to March 1967, the number of attack sorties declined. The diminished strike effort, however, belied the intensive planning that was taking place in preparation for the renewed campaign when the weather cleared. The QRC/160 pods became available in increasing numbers (100 in January, 107 in February, 170 in March), so that by 31 April, there were 205 operational pods available for the strike force.<sup>18/</sup>

The pods had dramatically proved their worth in Operation BOLD on 2 January when pod-equipped F-4Cs substituted for the usual flights of F-105s. Accompanied by six IRON HAND flights (a definite tactics change from one or two

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flights which normally flew with the force), the 48 F-4Cs successfully lured the MIGs up and shot down seven, with no U.S. losses to MIGs.<sup>19/</sup> Except for two attempts later in the month (one on 21 January which caused 21 U.S. aircraft to jettison ordnance),<sup>20/</sup> the MIGs stood down until April.

Their confidence restored against MIGs, strike pilots relied upon effectiveness of the QRC 160 pods.<sup>21/</sup> Reconnaissance squadrons, however, were reluctant to use them, as they believed the electronic countermeasure from the pods would disclose their position.<sup>22/</sup> Based on one QRC 160 and one aircraft, this presumably would be true, especially if ECM were employed from ingress to egress versus selectivity.<sup>23/</sup>

The effect of the pod on tactical planning was, however, becoming significant.<sup>24/</sup> The RF-4Cs, as well as the EB-66 squadrons, were evaluating and devising new procedures. Because "the EB-66 primary jamming tactic...during 1966 was to counter the SAM and AAA radars," NVN sites soon developed a lower frequency capability than could be jammed by the EB-66. "This realization, plus the addition of the QRC-160 fighter ECM pods...led, in March 1967," to the EB-66s attempting "to attack the entire enemy electronic defense system, not just a part of it."<sup>25/</sup>

Having been the main source of electronic intelligence (ELINT) information since the beginning of ROLLING THUNDER, the EB-66 was joined in the inventory just a few weeks later by an ungainly but effective counterpart, the EC-121K RIVET TOP. The RIVET TOP concept, originally designed as a follow-on passive ELINT gatherer, would play an extremely significant role of limited tactical air command and control.<sup>26/</sup>

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In addition to the changes in electronic tactics, a new weapon, the 1,100-pound, TV-guided free fall bomb, WALLEYE, was used for the first time during this period. Delivered with extreme accuracy by the Navy on 11 and 12 March, the WALLEYE did not come into the Air Force inventory until August. Although SHRIKE BDA had proved inconclusive, the frequent shutdown or frequency changing by NVN radars whenever SHRIKE-armed IRON HAND aircraft were in the vicinity attested to the usefulness of this weapon.<sup>27/</sup>

Until late March 1967, the tactics against NVN ground and air defenses had shown an interesting, if sporadic, development. Certain officials believed strongly that success could be achieved by better ECM; others, perhaps more traditionally, believed the only way to provide safety for the strike force was to destroy the sites themselves. The paradox which existed was this:<sup>28/</sup>

*"The basic philosophy of flak suppression is sound. However, we have never attempted flak suppression against such highly defended areas as those in NVN at the present time. Is flak suppression in this environment effective enough to warrant exposing the additional aircraft to perform the suppression mission?"*

Responding to another problem, 7AF had disapproved a recommendation from the November 1966 Tactics Conference at Ubon which would give IRON HAND pilots the authority to launch multiple SHRIKES to "saturate the high density SAM area," saying:<sup>29/</sup>

*"Unlimited high SHRIKE launches into the Red River Delta are not in consonance with current rules of engagement."*

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The seriousness of the threat was not lost on USAF commanders, however, despite the restrictions placed upon them by targeting procedures. On 4 January 1967, CINCPAC reviewed the situation. Unless something is done, he said: <sup>30/</sup>

*"...within a very short time the growing enemy air defense system will make air operations in the Hanoi-Haiphong region too costly for the type of targets we are now permitted to hit."*

CINCPAC recognized four alternatives: first, to accept losses without a commensurate return in targets destroyed; second, to expand the target list; third, to "attack the enemy's air defense system, including the MIG air bases and aircraft on the ground"; or fourth, to abandon the air war over the Red River Delta. <sup>31/</sup>

Again on 9 January, CINCPAC's "Goals for Evaluation of Progress in Southeast Asia" desired as its fourth objective to "reduce capability of NVN to interfere with our air operations over NVN, as measured by aircraft inventory, SAM inventory, and the friendly aircraft loss rate." <sup>32/</sup> But on 24 January, the Execute Order for ROLLING THUNDER 53 (RT 53) carried the same prohibition as had previous orders: "Not, repeat, not authorized to attack NVN air bases from which attacking aircraft may be operating." <sup>33/</sup>

The problem was summed up by 7AF on 29 January 1967: "Political restraints and geographical sanctuaries continued to circumscribe effects of airpower." <sup>34/</sup>

Outside the sensitive Hanoi-Haiphong area, however, the situation was somewhat different. The existence of a suspected SA-2 site near the DMZ as early as December 1966, had caused immediate reaction in the form of increased

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WILD WEASEL search and destroy operations, as well as additional pilots and crews assigned to protect the B-52s.<sup>35/</sup> By March, "7AF [was] no longer carrying this area in the current estimated SAM deployment";<sup>36/</sup> as a result, COMUSMACV<sup>37/</sup> immediately recommended that ARC LIGHT strikes in the DMZ area be resumed.

In the northern Route Packages, CINCPAC's strengthened February recommendation that "striking the primary MIG bases is the preferred counter action,"<sup>38/</sup> was followed shortly by RT 54 which, while allowing "appropriate elements of the forces" to "engage in combat, including SAM suppression, required to protect the strike force," nevertheless repeated the injunctions against attacking the MIG airfields.<sup>39/</sup>

Under the circumstances, the instructions which resulted from a meeting with CINCPAC on 27 February appeared mild. An effort would be made to identify and target "facilities in the vicinity of MIG airfields which, if attacked, would contribute to the disruption of air operations without striking the main runway and major airfield support facilities."<sup>40/</sup>

Consequently, the 7AF OpOrd of 2 March 1967 permitted nothing really new against NVN defenses. While it did grant tactical commanders more flexibility to "decide which targets command highest priority for attack during the short time frame" caused by operating against well-dispersed targets, it recommended only that "as the enemy increases his air defense, our forces must be provided increased IRON HAND and flak suppression support."<sup>41/</sup>

Accordingly, as the weather began to clear in late March 1967, no decision as to which tactics would be used had been reached. Despite CINCPAC's instructions

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that the intensified campaign was to "emphasize joint exploitation of new tactics, techniques, and counter defense munitions,"<sup>42/</sup> it was apparent that the odds for success were being placed more on improved ECM suppression than on active destruction.

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## CHAPTER II

### TARGETING AGAINST NORTH VIETNAM

Only infrequently in history had an enemy been able to operate effectively against U.S. forces from a privileged sanctuary. Even in Korea, the Yalu River boundary at least provided USAF a fixed geographic area for which to devise tactics. Not so in the Hanoi-Haiphong region, for as ROLLING THUNDER progressed, it became obvious that with the prospect of a long war, tactics must be developed against targets that would probably have to be struck, but were presently prohibited. There was no guarantee when, or for that matter, whether they would be placed on the authorized list. Thus, JCS targeting practices added a distinct, and as it turned out, significant variable to tactical planning.

CINCPAC's early proposals to counter the NVN defense system have already been noted; in addition, in February 1967, he had specifically recommended immediate attacks on Kep and Phuc Yen to assure "attrition of aircraft rather than major destruction of base facilities."<sup>1/</sup> Again in April 1967, CINCPAC called for a redevelopment of the strike concept in RP VI and contiguous areas: "Our forces must be prepared to counter new innovations, equipment, and tactics." The U.S. must devise "procedures to further degrade the [NVN] air defense system."<sup>2/</sup>

On 23 April, RT-55 Execute Order added Hoa Loc and Kep as approved targets to be struck by USAF and USN aircraft, respectively. The attacks, however, were to be "limited to small and random harassment strikes [of about eight airplanes] designed to attrite aircraft and disrupt support facilities." Additionally,

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"aircraft engaged in immediate pursuit (of enemy aircraft)" could attack only Hoa Loc and Kep.<sup>3/</sup>

What has been called the "harassment and disruption" of Hoa Lac and Kep Airfields,<sup>4/</sup> as well as restrikes against Kien An in April, May, and June 1967, accounted for 40 MIGs destroyed in the air and on the ground. U.S. losses during the same period totaled 98, the highest quarterly toll yet in the air war, including nine aircraft lost in May to 431 SAMs (usually fired in barrage), the greatest number of missiles yet in a single month.<sup>5/</sup> By 7 June, all operational MIGs still in NVN were concentrated on Phuc Yen and Gia Lam," the others having sought sanctuary in China.<sup>6/</sup>

Meanwhile, on 28 April 1967, positive photo and ELINT identification were made on RP I of a SAM site threatening the upper DMZ area. The reaction was immediate. Eighty-four sorties were flown against the site, nearly all of them directed by COMBAT SKYSPOT, in addition to USMC and USN artillery fire. Photo BDA showed five missile launchers, three transporters, numerous trucks, a van, and two AAA sites to the north destroyed.<sup>7/</sup>

Also in April, the monthly Summary of Southeast Asia Air Operations contained as an appendix, an analysis of "ROLLING THUNDER and the Rules of Engagement," suggesting in the conclusion that "ROLLING THUNDER results should be considered in the light of...operational restrictions in order to arrive at a logical evaluation."<sup>8/</sup>

On 2 May, CINCPAC wired JCS:<sup>9/</sup>

*"1. The number of air engagements during recent strikes against JCS numbered targets is indicative*

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of the increasing MIG threat to our forces. Attacks against the remaining jet capable field of Phuc Yen, Kien An, and Cat Bi are considered necessary at this time to further harass and disrupt the MIG air defense capability.

"2. The concept for attacking Kien An and Cat Bi would be the same as for strikes currently authorized against Kep and Hoa Loc. However Phuc Yen is heavily defended and should be attacked by larger forces in order to saturate the defenses. The primary objective would be attrition of MIG aircraft. The secondary objective would be that of disrupting support facilities associated with the bases. Strikes would be scheduled on a random basis."

A few days later, CINCPACFLT, commenting that NVN would go all out to defend her threatened MIG fleet, suggested diversionary strikes to flush the MIGs, then a follow-on strike 30 - 40 minutes later to inflict "major damage to target."<sup>10/</sup>

CINCPACAF agreed, noting the RT-56 order that "strikes against airfields be designed to maximize destruction" did "not require RT-55 limitation on strike force size." Accordingly, CINCPACAF ordered maximum strikes and suggested that attacks 20 - 30 minutes apart be used to catch MIGs on the ground.<sup>11/</sup> In May alone, 26 MIGs were destroyed, with a total U.S. loss in all Route Packages of 40 aircraft.<sup>12/</sup>

On 13 May 1967, CINCPAC once again "outlined [the] need to strike Phuc Yen, Kien An, and Cat Bi,"<sup>13/</sup> adding on 26 May, the suggestion for flexible strikes because "the NVN appears to be unable to maintain a maximized SA-2, MIG, and AA threat for more than a relatively short period of time."<sup>14/</sup>

The response from JCS was only a gradual relaxation of the Hanoi-Haiphong restrictions. On 20 July 1967, permission was granted for aircraft to enter

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the Hanoi 30-NM restricted area (but not the 10-mile prohibited area) and the Haiphong restricted area (but not the four-mile prohibited area) to attack "dispersed POL and SAM support facilities...after positive identification and after notification to Washington of plan to attack." Bases from which attacking MIGs staged could be struck only if they were "authorized for attack."<sup>15/</sup> And on 27 July, the rigidly controlled sortie allocation was made more flexible to allow CINCPACAF, CINCPACFLT, and COMUSMACV to adapt the total number of assigned sorties within their own areas of responsibility.<sup>16/</sup>

With this new flexibility, CINCPAC, citing the recent authorization for strikes within the ChiCom Buffer Zone, requested once again on 20 August that JCS permit "neutralization of Phuc Yen and the majority of its aircraft."<sup>17/</sup> CINCPACFLT added a week later the suggestion that strikes be made against the NVN Air Force Headquarters, Command Post, and Filter Control Center of Bac Mai.<sup>18/</sup>

The reply of CINCPAC on 30 August to CINCPACFLT was to request his commanders to draw up a plan "to conduct near simultaneous strikes against all usable airfields and major air defense control facilities in NVN." The objectives were threefold:<sup>19/</sup>

- To destroy as many NVN military aircraft as possible on the ground.
- To render all usable airfields in NVN unserviceable.
- To render ineffective all known major air defense command and control facilities in NVN.

Two days later, on 2 September, CINCPAC asked JCS to approve strikes against Cat Bi Airfield, due to extensive evidence of SAM storage and support

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facilities.<sup>20/</sup> Within the week, CINCPACAF provided CINCPAC with a joint plan to neutralize NVN defenses.<sup>21/</sup> On the same day, CINCPACAF also requested permission to strike a "radio communications transmitter station located about 4 NM NE of Phuc Yen," adding that "its destruction could possibly hamper high echelon links with Communist forces in Laos and SVN."<sup>22/</sup> Then, on 10 September, CINCPACAF requested more details from 7AF regarding the planned first strike against NVN defenses, plus "any other details which are necessary to secure approval."<sup>23/</sup>

Coincidentally, on 14 September, JCS asked CINCPAC to provide "recommendations as to an optimum" and "revised air campaign against NVN for a 12-month period beginning 1 November 1967."<sup>24/</sup>

On 16 September, CINCPAC's plan to attack the entire NVN air defense complex was submitted<sup>25/</sup> for approval by JCS.<sup>26/</sup> CINCPAC, requesting from JCS on 25 September that the total sortie allocation per Route Package be removed, also asked that all restricted areas be deleted, and that CINCPAC control airstrikes "against all targets in NVN."<sup>27/</sup> On 27 September, an execute message was issued. Phuc Yen and Kien An were to be attacked; USAF and USN forces were to "destroy all aircraft and support facilities."<sup>28/</sup> With approximately 180 aircraft lost, seven months after he had first asked to "attack the enemy's air defense system," specifically Phuc Yen, CINCPAC had been granted only another part of his overall request. Not yet authorized were Cat Bi or Bac Mai, the location of the NVNAF Hq, Command Post, and Filter Control Center.

Then, on 29 September, JCS withdrew permission for the Phuc Yen strike.<sup>29/</sup> Eleven days later, on 10 October, extremely concerned about morale of the

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expectant aircrews, CINCPAC asked that JCS follow up on the promise of "further notice" that the "stated restriction [was] expected to be lifted on or about [3] October 67." Noting that 47 aircraft were forced to jettison ordnance in September after being attacked by MIGs operating from strike-free bases and that on 2 October alone, 16 F-105s also jettisoned all bombs, CINCPAC concluded as follows: <sup>30/</sup>

*"The most effective method of denying an air capability to an enemy is the destruction of his aircraft on the ground and the neutralization of his airfields."*

Not until 24 October was the suspension lifted, and on that date, strikes were authorized against Cat Bi as well. <sup>31/</sup> On 24, 25, and 29 October, Phuc Yen and Cat Bi were struck, resulting in the destruction of both control towers (including a direct hit by a WALLEYE on the Phuc Yen tower) and destruction or damage to 20 MIGs. <sup>32/</sup> Further strikes were planned, but at the beginning of November, the excellent weather which had prevailed throughout most of October gave way to the annual northeast monsoon.

During November, a "change in permissible areas of air operations" allowed "aircraft engaged in immediate pursuit...to pursue enemy aircraft into restricted and/or prohibited areas [China excluded],"<sup>33/</sup> but on 15 December, the now familiar policy was once again spelled out: <sup>34/</sup>

*"Aircraft engaged in immediate pursuit are not authorized to attack NVN air bases from which attacking aircraft may be operating except Hoa Loc, Kep, Kien An, and Kep Ha."*

On 16 December, 7AF issued instructions to "add Phuc Yen after Kien An."<sup>35/</sup>

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No major changes in either ROE or targeting occurred until the bombing restrictions of 1 and 3 April 1968. During that period, although "NVN air defense elements were noticeably less active," this was so primarily as a direct result of diminished U.S. presence."<sup>36/</sup>

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### CHAPTER III

#### PARITY OR PERMISSIVENESS - APRIL 1967-MARCH 1968

April 1967 stands out as one of the most significant months in the entire ROLLING THUNDER campaign. There were the most SAM firings in one month, record MIG engagements (and subsequent record U.S. losses to MIGs), the highest number to date of AAA/SAM sites struck, and perhaps most important for the purposes of this report, the beginning of graduated approval by JCS to attack certain MIG airfields. As the pod began to demonstrate its effectiveness against the SA-2 threat, USAF aircraft adapted ingress tactics, coming in at higher and more constant altitudes. This procedure, however, made the force more vulnerable to MIGs, thus making necessary some form of retaliation against the entire MIG structure.

This phase of the air war, ending with the bombing restrictions of 1 and 3 April 1968, was a period in which the U.S. attempted to neutralize or at least achieve parity with the NVN air defense system. Targeting problems notwithstanding, tactics had to be devised, and in the early months of 1967, the QRC-160 pod was the most significant new item of equipment yet introduced into the air war. But the pod was no panacea. While it did provide a measure of ingress and egress protection, it created problems as well. "The pod formation, while optimizing electronic countermeasures, complicates the dive bombing delivery program," said one study. "No one but lead attains the desired roll-in point."<sup>1/</sup>

Many variations in pod formation were tried. In January 1967, the 355th

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TFW evaluated three methods: <sup>2/</sup>

OZARK: QRC pods used, 500 feet line abreast; weaving vector used.

LEECH: QRC pods used, 1,000 to 1,500 feet vertical, lateral, and line abreast, weaving and moving vertically.

CRAB: All formations weaving, moving vertically, heavy AAA, effective.

Vector used on eight flights, using different tactics without pods; however, where pods were ON and formation separation over 1,000 feet, AAA was not as effective.

By September, 7AF was recommending a further refinement: <sup>3/</sup>

*"The following tactics will be tested and evaluated for F-4 and F-105 aircraft on missions in high SAM threat areas or AAA. Escort flight of four aircraft with two pods each. Two flights of four strike aircraft which will change from pod to closed formation in minimum time before dive on target. Escort flight will be provided ECM protection during close formation and dive vulnerability period.*

*"Upon reaching high threat area, assume pod formation. Distance between flights--1,500 feet. Escort flight splits with two aircraft on each side of Strike flights (1,500 feet). Sixty seconds before bomb release time, close formation assumed. Escort flight moves into 1,500 foot distance. After strike, flights will quickly resume pod formation."*

In January 1968 another adaptation was made: <sup>4/</sup>

*"Optimum operational pod formation considered to be at least 1,500-foot separation in all directions (lateral,*

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vertical, and in trail) with one odd\* and one even\* pod per aircraft. This information (flight of four aircraft) represents a total area coverage of 4,500 feet in both azimuth and elevation, or 6.3 and 6.0 degrees of jamming to FAN SONG radar at ground level. The total area of coverage and degree of jamming vary with aircraft altitudes and aspect angle of formation."

Irrespective of variations in techniques (Figs. 3, 4, and 5), the pod became standard required equipment in April 1967:<sup>5/</sup>

"Each aircraft flying into SAM high threat areas will be equipped with an operational pod. When sufficient pods are available, each aircraft should be carrying an odd and an even pod. Jammers should be ON before entering high threat area to deny the defense radars range and elevation data. IRON HAND flights of four aircraft should have at least three aircraft equipped with pods."

\* FAN SONG B radar had a frequency range from 2,920 - 3,060 MHz with the lower azimuth, vertically polarized, operating up to 3,000 MHz. The upper azimuth, horizontally polarized, operated between 3,000 - 3,060 MHz. As a result, two separately configured pods, one with a vertical antenna, the other with a horizontal one, were used for optimum jamming. <sup>6/</sup>

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The results in June 1967 seemed encouraging: <sup>7/</sup>

USAF COMBAT LOSS RATES: (Per Attack Sortie) Before and After  
QRC-160/ALQ-71 Pod Utilization--All Route Packages

	<u>Jul - Sep 1966</u> <u>(Before Pod)</u>	<u>Sep 1966 - Jun 1967</u> <u>(After Pod)</u>
SORTIES	18,882	39,282
LOSSES	70	82
LOSS RATE	.0037	.0021
LOSS RATE (RP VI)	.0276	(.0067)

Above all, as pod utilization provided aircraft increased protection from radar controlled ground weapons in the middle altitudes, tactical planners could exercise greater flexibility. Earlier, losses to conventional AAA had necessitated a change from the early tactic of coming in at a very low level with terrain masking, then popping up to 12-14,000 feet for target acquisition, followed by egress at treetop level with jinking turns. This technique had been changed to trial flights at from 4,000 to 10,000 feet with 40-NM separation, but the strike forces then became vulnerable to MIGs and SAMs. <sup>8/</sup>

Now, however, in mid-1967, as the SAM operators adjusted and began firing in barrage (in March and October, for instance, 431 and 582 SAMs fired, respectively), <sup>9/</sup> a recommendation was made to return to a low-level profile for part of the force to provide a more varied ingress tactic. <sup>10/</sup>

By July, an interesting trend became obvious. SAMs were not being fired at the USAF pod-equipped strike force. From 11 June to 31 July, of 256 SAMs

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# OPTIMUM POD FORMATION

(VARIATIONS USED IN PRACTICE)

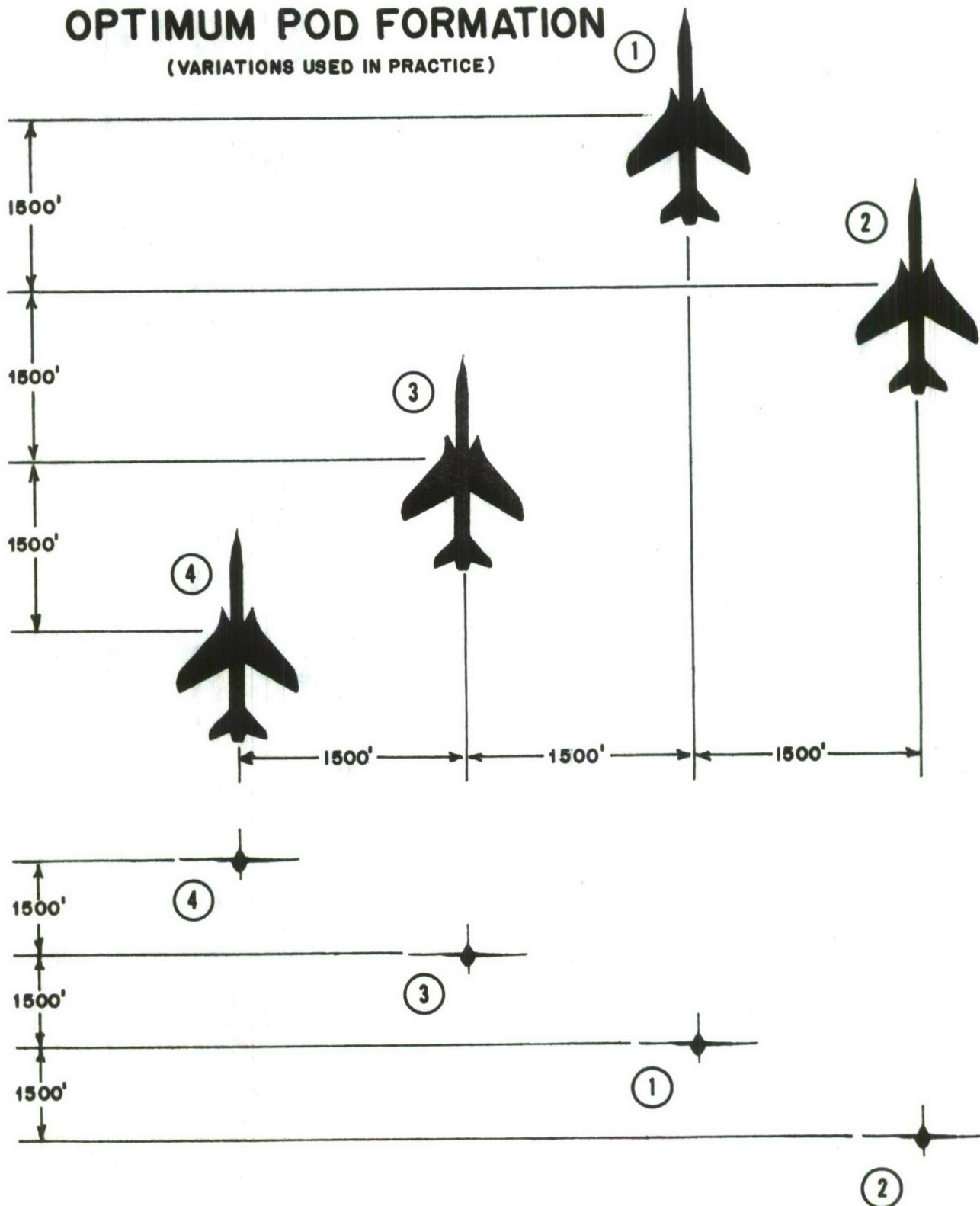


FIGURE 3

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# 355th TFW POD FORMATION

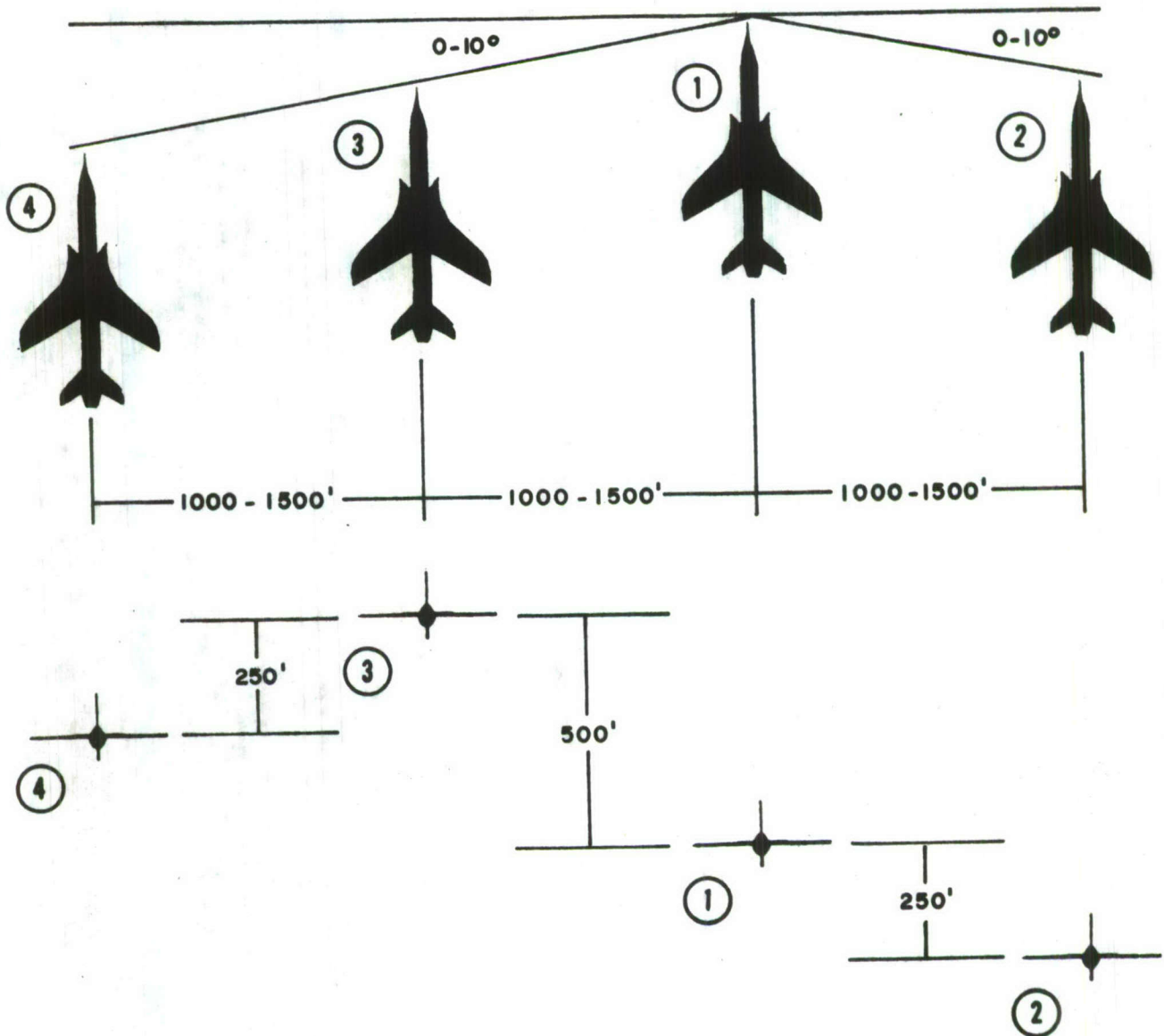


FIGURE 4

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# 388th TFW POD FORMATION

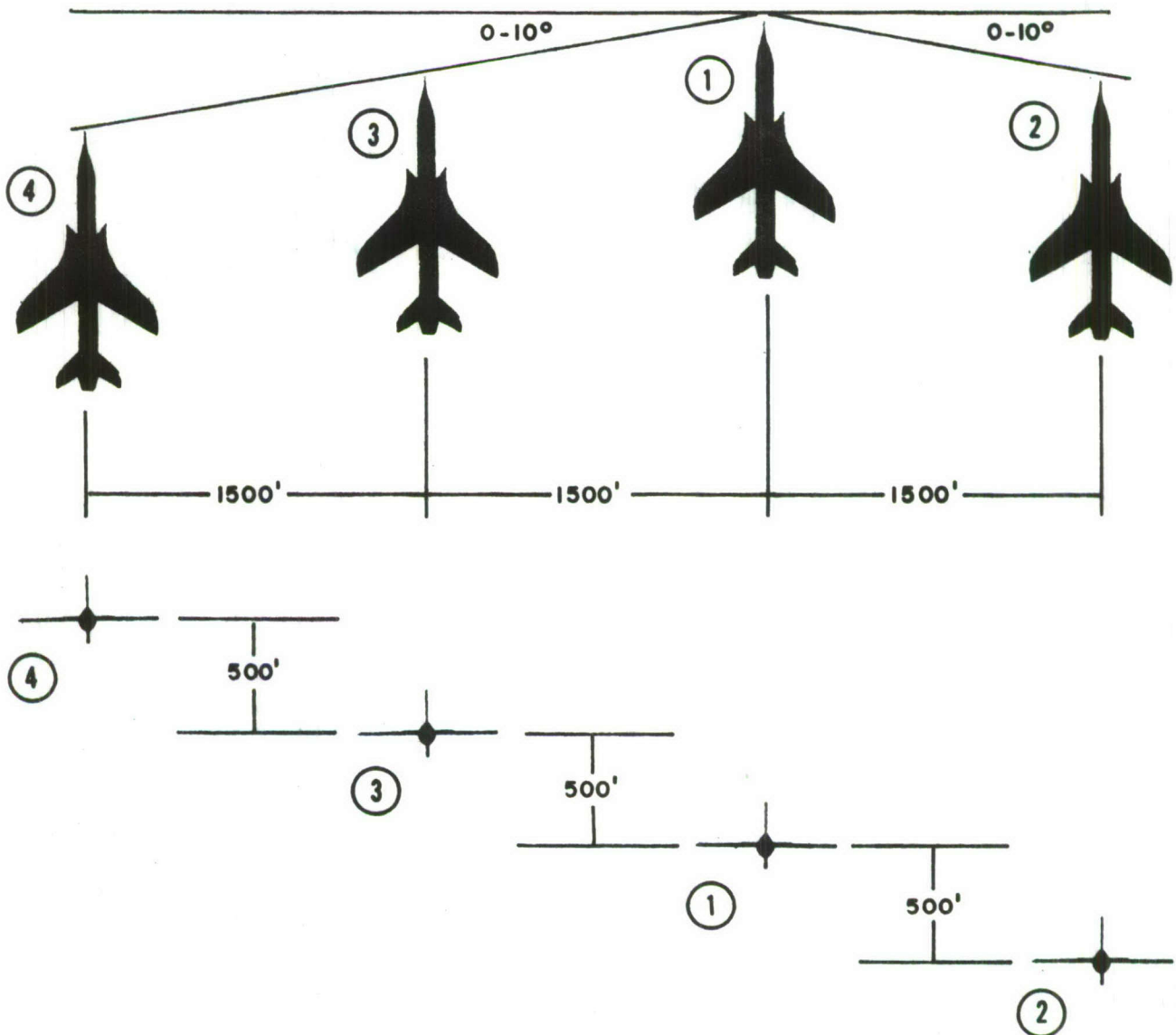


FIGURE 5

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reported, only 42 were shot at USAF aircraft, most of them at recon and their fighter escorts. The remainder had been fired at USN aircraft which were carrying only the ALQ-51 jammer. Just 10 pod-equipped aircraft had been lost, none to SAMs and eight had definitely been lost to barrage AAA with little indication of successful radar guiding.<sup>11/</sup>

The trend seemed to continue into October. By the end of the month, the pod had apparently provided a relatively safe envelope to and from the target. Twenty-six of 33 strike losses (79%) during this period were in the target area; previously, in 1966, the ratio had been 48.9 percent in the target area. From 1 July to 31 October 1967, 38 pod-equipped aircraft had been lost, but only 13 to radar-guided weapons (6 to SAM; 7 to 85-mm AAA), and in almost all cases, heavy barrage SAM and AAA were reported.<sup>12/</sup>

Then, in November 1967, eleven U.S. aircraft were lost to SAMs, the highest number in any one month of the air war. In fact, analysis of the RP VI attack sortie/loss rate for October and November revealed a new trend. The USAF loss rate climbed to .0104 in October and to .0164 in November, figures which surpassed the previous year's averages shown previously. This overall loss rate for November was "the highest experienced since April 1965."<sup>13/</sup> The increased pressure on targets in the Hanoi/Haiphong region, coupled with the barrage SAM/AAA, and the integration of the MIG/SAM/AAA environment, had, despite the pod, created a survivability situation which was only slightly better than it had been before employment of the QRC-160 pod. And even with the sharp drop in combat sorties for January 1968 (only 8 percent in RP VIA), the 2,942 USAF attack sorties in NVN produced 11 losses for an overall ratio of .0034.<sup>14/</sup>

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The fact that the overall loss rate was again rising led the USAF Tactical Fighter Weapons Center to propose that "a complete reevaluation of the present strike force employment should be considered." Suggested were the employment of "two strike forces against dispersed targets with the same TOT," the splitting of the force into "individual flights of four" to "attack dispersed targets," and above all variety in TOTs and ingress routing. Only if these "recommended concepts...are employed in an unpredictable pattern will they achieve some success," the report concluded.<sup>15/</sup>

But with the northeast monsoon in full swing, the strike forces were never to return in large numbers to Route Packages VIA and VIB, and at the time of the bombing halt in April 1968, the future effectiveness of the pod in reducing the overall loss rate, despite its brief flurry of success, was still questionable.

#### EB-66 and RIVET TOP

The pod was not the only innovation to appear in theater during the period before the bombing restrictions. The role of the EB-66s was substantially changed, and in August 1967, RIVET TOP arrived.

The change in the EB-66 role resulted directly from the introduction of the QRC-160 pods. Because the pods did a better job of jamming terminal defense radar, EB-66 tactics had become directed more toward countering the NVN early warning and acquisition capability.

By June 1967, the EB-66 orbits were in western NVN and above the Gulf of Tonkin, but as the North Vietnamese began installing SAM units along Route 6 as

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far west as 104 degrees longitude and because the MIG CAP was withdrawn in July, the western orbit of the EB-66 was moved south of the 20-degree parallel. Its effectiveness, "inversely proportional to the distance from the radars being jammed, was drastically reduced."<sup>16/</sup>

With improved capability to receive MIG warnings, plus the resolution of UHF interference problems, the EB-66 western orbits were soon moved up to 21 degrees North latitude. When the NVN defenses began to concentrate more around Haiphong/Hanoi as the JCS targeting policies diminished the restricted circles, EB-66s were authorized in late November to orbit north of Thud Ridge, protected by MIG CAP. But when MIGs made an unsuccessful attack on 20 November, "the decision was made that the EB-66 was too vulnerable to...operate north of Hanoi, despite the fact that these orbits improved EB-66 effectiveness."<sup>17/</sup>

Soon there was another variation:<sup>18/</sup>

*"In December 1967, a major tactical change was introduced as preplanned routes, specific jammer-on points and 'packages' were employed for the first time. These tactics consisted of routes utilizing crossing tracks and various chaff loads, including delayed opening chaff (DOC)....The orbit areas remained virtually the same during this period."*

Unfortunately, one strike force support mission involving these newer tactics was unsuccessful on 18 December 1967 when the fighters entered the prescribed chaff drop area 21 minutes off the time expected by the EB-66s. "Since the strike force was well inside the burn-through range when AECM was committed, the NVN probably had good radar tracking of this strike force."<sup>19/</sup>

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Generally speaking, the EB-66s were only partly successful in degrading NVN radar defenses. By the end of this period, "increasing the number of EB-66s seemed the only feasible way to increase their effective transmitted power-output." Where there had been one to four aircraft in a given orbit early in 1967, "by December, as many as 14 aircraft" of both USAF and USN "provided support for Strike forces."<sup>20/</sup> Their vulnerability having forced them too far away to be consistently effective, the EB-66s exemplified if not complete success, at least USAF persistence in attempting to degrade NVN defenses.<sup>21/</sup>

In addition to the distance from the NVN radar, the EB-66 role underlined a weakness in suppressive tactics, that of command and control. Designed only to jam and advise, they could not provide the immediate assistance necessary to destroy either the MIG or SAM threat. RIVET TOP, the specially modified EC-121K, was to do just this. Originally programmed "to support IRON HAND...and to assist in the defense of daylight flights of ROLLING THUNDER," RIVET TOP's function had evolved into the following priorities:<sup>22/</sup>

- Assistance and direction of the strike force.
- SAM (and MIG) warning and detection.
- EOB search.

After flying its first fragged combat mission on 30 August 1967, RIVET TOP, now a further modified EC-121M, not only became an integral part of the COLLEGE EYE command and control network, but "some of its specialized equipment, designated RIVET GYM [had been] installed in four COLLEGE EYE aircraft in late 1968."<sup>23/</sup>

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Although the increased NVN ground-controlled intercept effectiveness contributed to the loss of six U.S. aircraft to MIGs in November 1967, the standdown to facilitate modification of RIVET TOP during part of that period had proved disadvantageous. CINCPACAF desired utilization of RIVET TOP to the utmost. <sup>24/</sup>

On 6 October, "RIVET TOP obtained permission for direct communication with the strike force," and from October through March was involved in the detection and destruction of ten MIGs confirmed and five more probables. <sup>25/</sup> Attesting to its value were the pilots themselves. The 388th TFW Deputy Commander for Operations said, "RIVET TOP has provided outstanding real time MIG information to our strike force." Others had "nothing but positive comments" on RIVET TOP's "calls and vector work." Several asked, "Where do they get that kind of information?" The answer by an intelligence officer was, "I don't know. But we mutually hope they keep it up." <sup>26/</sup>

The major value of RIVET TOP lay in its ability to control and vector strike missions against SAM and MIG defenses, but the bombing restrictions cut short its continued evaluation in the high threat area.

#### Reconnaissance

While elements of the ECM suppression effort were attempting to produce successful tactics which would counter as a whole the NVN radar threat, certain key supporting units were working, often seemingly alone, on their own particular problems with NVN air defenses. Such a case occurred with the reconnaissance aircraft, the RF-101s and RF-4Cs which provided pre- and post-strike photography.

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Having one of the most important missions of the war, the recon pilots developed their own individualized tactics.

Prior to the introduction of the pods, RF-4C pilots of the 432d Tactical Reconnaissance Wing, for instance, employed tactics which: <sup>27/</sup>

*"...varied depending on the mission...and from crew to crew. As an example, some crews preferred to fly high out of the way of small weapons fire and take their chances on missiles, while others preferred to stay low, taking advantage of terrain cover and surprise."*

The RF-101 pilots acted similarly. Generally using a terrain masking ingress, a pop-up near the target, and a low-level egress, they normally used "flights of two aircraft in heavily defended areas." Lead would provide navigation and target acquisition, while the wingman would cross-check and provide alert for defensive countermeasures. <sup>28/</sup> Nevertheless, "each had his own feeling of what has [worked] and will continue to work for him." <sup>29/</sup> One squadron had lost two aircraft by 31 December 1966; one had been shot down while ingressing at 3,000 feet, "contrary to all previous tactics employed by the squadron." <sup>30/</sup>

By April 1967, attrition was increasing. The cumulative RF-4C loss rate, previously .0016, had jumped to .0023 (.0049 in January), approaching the .0033 rate of the RF-101. To date, no ECM pods had been used. <sup>31/</sup>

In January 1967, Seventh Air Force imposed restrictions on photo reconnaissance missions in RPs V and VIA. Mandatory flights of two aircraft, maximum use of the night capability of the RF-4C, escorts provided by pod-equipped F-4Cs, and a delayed time (12-24 hours) between strike and BDA photography were

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among the changes. On 10 February, further instructions were issued to raise minimum ceilings for night photo and infrared missions, and aircraft were to fly no lower than 12,000 feet AGL on all daylight sorties.<sup>32/</sup> The plan by April was to equip all RF-101s with ALQ 51 ECM equipment and to convert all RF-4Cs to the QRC-160 pod as soon as possible.

With this capability, tactics changed:<sup>33/</sup>

*"The time period was extended at 'altitude' taking advantage of ECM to obtain increased photo coverage. Flights ingressed at medium altitude (15-20 thousand feet), relying on high, fast flying, jinking, and ECM to avoid enemy defenses."*

According to one squadron commander, the need for tactics revision was created by two factors: "(1) increased enemy ground fire; and (2) an increased number of fragged targets within a 35-mile radius of Hanoi." The new pod seemed to work well, and with the higher altitude profiles being flown, MIG CAP was provided toward the end of June 1967, much to the satisfaction of the pilots.<sup>34/</sup>

To evade SAMs on egress, some RF-4C pilots developed the "slice," a hard (5-6G) 120-135-degree slightly descending turn initiated when coming off the target. By December 1967, "most crews [had] elected to use it."<sup>35/</sup>

The pods, however, did not seem to be living up to expectations. Other methods were tried:<sup>36/</sup>

*"Because of enemy defenses, especially SAMs, the [COM-MANDO CLUB] mission broke off short of the target on several occasions. On one of the occasions, the flight encountered 16 missiles. On another...the flight was escorted by both MIG CAP and IRON HAND support. The flight was jumped by four MIG-21s."*

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Increased losses "prompted revised day tactics. The pop-up maneuver returned to frequent use as did lateral jinking, and a more individual, rather than stereotyped atmosphere, prevailed to the end of December."<sup>37/</sup>

To make the individually revised tactics more formal, the 432d tactics panel met in December to determine whether the high level profile had indeed been compromised. The panel decided that NVN had succeeded in deriving "an effective counter to tactics used...not [to] the ALQ-71 ECM pod itself." A combination of barrage SAM and MIG activity had disrupted pilots who had become "stereotyped in their routes, altitudes, and general procedures involving the pod. Aircrews should realize," the panel continued, "that this ECM equipment is designed to augment other tactics and [is] not a 'tactic' in itself."<sup>38/</sup>

Recommended were more use of low level ingress, variances within the pod formation, and more lateral jinking. Especially important was a modified return to the earlier pop-up maneuver with an egress at 5,000 - 8,000 feet, an altitude, the panel believed was "high enough to avoid automatic weapons, yet increase visual acquisition and maneuverability against the SAM."<sup>39/</sup>

By spring of 1968, both pop-up and ECM pod maneuvering tactics were being used, but to the reconnaissance pilots "another threat became increasingly ominous as MIGs became more and more aggressive."<sup>40/</sup> For protection, more MIG CAP would have to be diverted from the primary strike force, but the bombing restrictions relieved the reconnaissance aircraft from flying pre- and post-strike missions in the high threat areas.

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#### WILD WEASEL/IRON HAND

To the F-105 pilot, whose job it was to suppress and destroy the SAM/AAA positions, there was no such thing as a low threat area. Each strike force included at least one and usually two flights of F-105D/F-105Fs whose mission included not only strike force protection, but often served as bait for the AAA and SAMs by flying a profile appropriately entitled "trolling."

Their function, as it evolved, was twofold. Originally acting as WILD WEASEL, Hunter/Killer flights, by the end of 1967, they were performing two distinctly different roles. As pointed out by a late tactics conference, there had evolved: <sup>41/</sup>

*"...a clear difference between the WILD WEASEL and the IRON HAND (IH) missions. WILD WEASEL consists of an electronic and visual search for SAM positions and the destruction of those positions and associated hardware. IRON HAND consists of providing an electronically guarded corridor through which the strike force can pass with the warning capability and protection (strike threat) provided by the F-105/F/D. The IRON HAND mission is primary of the two under our present method of operation."*

During the changeover to pod formation and tactics, the IRON HAND aircraft were particularly vulnerable, as well as being primary targets for SAM and MIG attacks. During April, for instance, four IH F-105s were lost, <sup>42/</sup> but as the NVN crews came to respect the suppressive ability of the SHRIKE-bearing IH aircraft, they too changed their tactics. "They became extremely selective in the targets at which they launch missiles," said one commander in July. "The total effect has resulted in...tactics being flexible, so that rapid adjustment can be made to the changing environment. The success of the tactics is evident in the crews lost versus sites destroyed." <sup>43/</sup>

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By the end of the year, a total of 1,923 AA/AAA and 227 SAM sites were declared destroyed or damaged, nearly all as a result of IRON HAND tactics. Unfortunately, the increased mobility of NVN defenses resulted in 5,000 more prepared AAA sites constructed during the year and a slight increase (800) in the number of sites occupied. <sup>44/</sup>

Although the IH flights, together with use of the pod by all strike aircraft, did suppress the NVN radar and allow more destruction of AAA/SAM sites, the increasingly sophisticated NVN air defense system, coupled with intermittent barrage missile firings, continued to severely harass the strike force. But the concept of strike force integrity remained paramount; it was up to the IRON HAND and WILD WEASEL flights to attack the defenses themselves. The 7AF OPlan 512-8, The Northeast Monsoon Campaign, dated 15 September 1967, granted the force commander authority "to divert strike flights from primary targets to assist in destruction of SAM sites visually acquired." On the other hand, the 7AF OpOrd 100-68 for ROLLING THUNDER of 15 December 1967, prescribed no such tactic. IRON HAND and WILD WEASEL flights, however, attacked mainly in the lower Route Packages, either on armed recon or diverted missions. <sup>45/</sup> In the north, the in-flights usually stayed with the strike force, one flight entering the target area slightly ahead of the main force, the other behind or to one side. Also, IRON HAND was the last to leave, often circling the target to suppress radar and SAMs which might come up on the departing U.S. aircraft.

Once established in mid-1967, IRON HAND tactics varied only slightly during the year. The main change was in formation position. For example, early 355th TFW tactics had IRON HAND's second element about 10 - 20 degrees back, 1,500 feet out, stacked slightly high. <sup>46/</sup> By December, however, the formation was

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spread even farther. The elements were 2,000 - 3,000 feet out, and for MIG coverage the spacing was widened to a nearly line-abreast 5,000 - 7,000 feet. <sup>47/</sup>

Such tactical evolution, coupled with "the professional dedication and experience of the crews...deceived the SAM operators and resulted in a number of extremely successful sorties." <sup>48/</sup>

#### Other Tactical Considerations

These statistics show the suppressive effect of the SHRIKE anti-radiation missile and attest the respect NVN missile crews had for the weapon. Reactions (missile launch) were compared when SHRIKES were launched/not launched, and a potential target was within 15 NM of the occupied site. Results are as follows:

#### INFLUENCE OF SHRIKE ON SAM REACTION (Oct 1967 - Mar 1968)

	NOT SHRIKED OPPORTUNITIES	REACTED	SHRIKED OPPORTUNITIES	REACTED
Oct	174	59	58	3
Nov (17, 18, 19,20)	43	36	38	5
Nov (1-16 21-30)	60	21	30	0
Dec	80	42	34	0
Jan	49	30	69	1
Feb	90	37	35	2
Mar	64	25	45	5
TOTALS	560	250	309	16

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As a further indication, perhaps also providing an explanation of the loss in November 1967 of 11 U.S. aircraft to SAMs, these late comments are pertinent: <sup>49/</sup>

*"Since the SHRIKE's introduction, the percentage of SAMs fired with radar guidance has been greatly reduced. The far greater number are fired in salvo and are unguided because the ground sites cannot afford to stay on the air. This has greatly reduced their effectiveness and has been a big boost to the morale of the strike pilots."*

*"It should surprise no one that an increase in SAM firings and an increase in SHRIKE firings occur at the same time. Most SHRIKE launches are the result of SAM activity and launch warnings."*

The SHRIKE, however, could not, because of its small warhead, guarantee the SAM site destruction that was necessary. As a consequence, a follow-on weapon, the AGM-78 STANDARD ARM, initially used by the Navy on 6 March, was carried by IRON HAND on 9 March and fired the next day for the first time. STANDARD ARM was an air-launched, tail-controlled, anti-radiation missile which promised to combine the destructive potential of CBU 24/29 with the accuracy <sup>50/</sup> of the SHRIKE. One pilot was particularly enthusiastic:

*"It has a longer range and a larger warhead. It can go through a 180-degree turn. It also has a memory mode-- if the FAN SONG shuts down, it continues to guide on its course."*

The U.S. was not alone in introducing new weapons. In March, a Special Forces team found a cache in RVN of 23-mm AAA ammunition, and evaluation confirmed "its use for the Soviet-built, air-droppable ZU-23-mm gun." Further conclusions confirmed "the likely presence of this weapon in RVN and also points

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to the probability of its being in North Vietnam, where it has not yet been carried in the AAOB."<sup>51/</sup> Possessing a cyclic rate of 800-1,000 rounds/min/gun, this weapon, according to one study, "would represent a decided escalation in quality of Soviet weapons to North Vietnam."<sup>52/</sup>

To the Red River Rats and to those other fighter pilots who had fought the formidable NVN air defense system to what they considered barely a draw, the real air war in the North was essentially over on 1 April 1968. Compared with the Hanoi/Haiphong region, the lower Route Packages have been considered a piece of cake. There, defenses had been satisfactorily prohibited, countered, and destroyed, and the loss rate, when compared to Route Packages V, VIA, and VIB, had been extremely low.

The question was--would it remain so? Earlier, when first queried about whether there should be a bombing rollback, CINCPACAF had warned:<sup>53/</sup>

*"Restrictions of missions to below 20 degrees North will permit the enemy to concentrate his AAA and SA-2 defenses south of 20 degrees comparable to that now found in the Hanoi/Haiphong area. SA-2 Missile sites could be placed in a sanctuary immediately north of 20 degrees and, thereby, make the area above 19 North untenable."*

Once again at a major turning point in ROLLING THUNDER operations, the U.S. was forced to wait and see what the NVN air and ground defense system was going to do.

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#### CHAPTER IV

#### SUPREMACY: TACTICS, TARGETING, OR GEOGRAPHY APRIL - NOVEMBER 1968

A significant Interdiction Area study published in April 1968 (no doubt written without a bombing restriction in mind) concluded that "opportunities for further reduction of losses in SEA appear to be more in the line of new or modified systems than in revision of tactics."<sup>1/</sup> As events turned out, nothing could have been farther from the truth. For it was not primarily the introduction of new systems, but rather the unleashing of its suppressive forces, using equipment and tactics already in the inventory, that accomplished what so many had been begging to do for so long: "kill the SAM and suppress the AAA."

Many factors, however, must be considered. By 3 April 1968, the major U.S. strike effort was directed into an area less than one-third the size of that which had previously required coverage. Targets were not as concentrated nor as fixed, therefore more true interdiction missions were flown. Distances to targets were not as long; therefore more armed reconnaissance was fragged, with more time available over target. On the NVN side, the gun crews, having developed extreme mobility in their habit of shifting guns and SAMs from emplacement to emplacement, found the transportation network in the lower Route Packages much less compatible than in the more developed North. In effect, the situation south of the bombing line resembled a much earlier one, except that this time the line was the 19th parallel, not the Yalu River.<sup>2/</sup>

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#### NVN Defenses - Lower RPs

According to one source, "following the 31 March bombing restrictions, RP I enjoyed the greatest concentration of antiaircraft weapons per square mile seen during the conflict."<sup>3/</sup> On 1 April, "the verified gun count (total guns of all calibers)" in RP I was 1,442. By August it had increased to 2,100.<sup>4/</sup> From March to August 1968, fire control radars in RP I increased from 20 to 41, but during the same period NVN was able to increase its operational SAM strength by only one unit--from three to four.<sup>5/</sup>

As for the MIGs, the freedom granted them to rebuild, reequip, and retrain should have presented the U.S. with a formidable threat, but it did not. Greatly responsible was the GCI and SAM system established by the U.S. Navy which, coupled with USAF and USN aircraft, presented to the MIGs the same kind of defense previously faced in NVN by U.S. pilots.

Generally speaking, the 35 USAF aircraft lost on attack sorties in the seven-month period from April through October 1968, were hit by non-radar guided barrage fire, used, as one analyst phrased it, "to distract aircrews during attack approaches. When successful, it increased the circular error probable of weapons delivered." The general outcome of this tactic, the report concluded, "is measured in reduced effectiveness of weapon delivery rather than hit or downed aircraft."<sup>6/</sup>

#### Electronic Countermeasures

Following the April bombing pause, NVN began rebuilding, while USAF introduced new and refined ECM equipment to counter NVN defenses. Except for the new QRC-335 pod, however, none of the advanced systems was used successfully

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in combat.

The QRC-335 was an advanced pod which incorporated all the features of its predecessors, but in addition was designed so as not to suppress the RHAW gear of its own aircraft as the QRC-160 had done. Further, it was effective against both the manual and automatic tracking modes of the FAN SONG radar. The first wing to be equipped with the QRC-335 was the 432d TRW, Udorn RTAFB, Thailand.<sup>7/</sup> In mid-April, the new pods were operational.

By August 1968, 90 QRC-335 pods had arrived. When added to the ALQ-51 and 71, and the QRC 160-1 and 160-8 pods already in service, a total of 663 pods were available for USAF aircraft.<sup>8/</sup>

Also ready for operation when the bombing restrictions were ordered were five specially configured F-105Fs designated COMBAT MARTIN. Equipped with the QRC-128/ALQ-59 pod, their mission was GCI communications jamming to prevent enemy controllers from vectoring MIGs against the strike force. Because of their sensitive nature, the COMBAT MARTIN concept was never actually used.<sup>9/</sup>

Also designed to deter the NVN GCI capability were experimental systems called BASS I and II. From 24 August to 27 September 1968, four F-105s of the 388th TFW were modified to work in conjunction with RIVET TOP directed strikes against radiating FAN SONGs. A total of 12 missions were flown before the project was halted because of repeated systems malfunctions.<sup>10/</sup> It was not tested again in SEA.<sup>11/</sup>

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WILD WEASEL/IRON HAND

Although there were no major tactics changes effected during this period, the WILD WEASEL role came back into prominence. FREE TROLL missions were often fragged--sorties which amounted to armed recon against SAM and fire control radars. If the radars came up, "the IH flights were able to pinpoint and subsequently destroy the radar sites. This 'Hunter-Killer' role for the IH proved extremely effective in suppressing radar activity."<sup>12/</sup>

When IRON HAND aircraft did fly with the main strike force, they needed a slightly revised tactic. Now carrying the AGM-78 STANDARD ARM missile, IRON HAND was to be placed farther ahead than the usual one to two minutes of the strike force. Because of their vulnerability, it was recommended that IRON HAND flights also be given their own MIG CAP.<sup>13/</sup>

For the first three months after the restrictions, IRON HAND targets struck by the 44th TFS, Korat RTAFB, Thailand, were "in almost all cases... [areas] of suspected SAM activity, i.e., photo-occupied SAM sites, prepared and/or revetted launch positions, field deployed sites, or missile transporters."<sup>14/</sup> By June 1968, as a result:

*"Few signals of a threat nature are noted now, due to the extreme respect of the North Vietnam radar operators for the IH flights. During the past three months there has not been one confirmed SAM firing during the times when 44th TFS IH flights were trolling."*

The cumulative score for the 388th TFW during the period from April - June 1968 was 93 SAM-prepared sites struck, one fire control site destroyed, four GCI/EW sites damaged, 66 weapons sites damaged, and 96 weapons sites destroyed.

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Even with this activity, "combat losses of five aircraft [were] the lowest in recorded Wing history."<sup>15/</sup> Nevertheless, some noted a "difficulty in maintaining aircrew proficiency and high morale within the limitations imposed on the F-105F due to its 'critical resource' designation."<sup>16/</sup>

Only a LEAD or a SAM site which had actually launched a missile could be strafed by IRON HAND F-105Fs. The LEAD was a prepared SAM site, which by Air Force criteria, had a high probability of being occupied by SAMs or SAM-associated equipment. Ordnance could be expended only on a SAM site designated as a LEAD by 7AF.<sup>17/</sup> Others became concerned, however, about the kinds of losses being experienced:<sup>18/</sup>

*"It may be true that the F-105/M-62 gun combination is more effective below 4,500' AGL; however, there has been a significant F-105 loss rate attributed to F-105 aircraft strafing in RP I....Although it could not be determined from the LOSREPs, the exact altitude the [five] aircraft were hit while strafing; it still is considered an unacceptable risk to strafe below 4,500' AGL in nonpermissive areas."*

In general, IRON HAND/WILD WEASEL tactics were constantly successful, given the targets and the permission to strike them. Tactics already developed were intensified, such as the introduction of "a comparison file for each active SAM site. With the help of photo interpretation [by] Wing Intelligence officials," daily photos "were compared with previous strips to determine if any change had occurred in the physical environment." Also established was a strike log:<sup>19/</sup>

*"The bombs dropped by the 355th and 388th Tactical Fighter Wings on active SAM sites were logged each day. The crew planning missions for the coming day used this log to pick new targets not previously hit. This harassment would deny the enemy the time to*

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*establish good site locations and calibrate equipment."*

Thus, by denying the NVN crews what has already been called their most precious commodity, time, the IRON HAND/WILD WEASEL forces were able successfully to make the environment relatively safe for the strike aircraft.

#### The MIG Barrier

After the bombing restrictions, there was evidence that the MIG force, well-trained and well-integrated with the SAM/AAA in the northern Route Packages, was preparing to engage U.S. strike aircraft. On 14 May, the sizable Vinh GCI facility with coverage well below the DMZ was struck. What was called at first a "temporary setback" to the NVN GCI capability (on 23 May 1968, a "sizable MIG force" ventured south of the 19th parallel for the first time) turned out otherwise, for NVN was never able to maintain anything like the radar capability it had previously enjoyed.<sup>20/</sup> From then on, MIGs venturing south did so for the most part under strict radio and radar silence, preferring to use high speed "hit and run tactics, usually consisting of a single firing pass, followed by a retreat north of the 19th parallel."<sup>21/</sup>

One of the deterrents to further MIG action appeared to be the Navy's TALOS SAM capability which achieved its initial MIG-21 kill on 23 May 1968, the occasion of the first and last sizable MIG foray south.<sup>22/</sup> Not possessing any appreciable airborne electronic counter-countermeasure (ECCM) of its own, the NVN MIG force preferred to stay out of what had suddenly become an untenable SAM environment, made so largely due to NVN's unwillingness to attack U.S. naval vessels.

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To develop this turnabout situation further, U.S. aircraft were instructed to use a "clear fire" area tactic. Whenever MIGs were detected below 19 degrees North, all tactical aircraft would immediately exit below 18 degrees North to give the Navy clear targets for its SAMs."<sup>23/</sup>

During the July - September period, four MIG-21s and two MIG-17s were downed; including one to a second TALOS.<sup>24/</sup> Total engagements from April through October 1968 were 18; 7 MIGs were shot down, with two U.S. losses from enemy aircraft.<sup>25/</sup>

#### The Strike Force

With defenses suppressed to an acceptable level, the strike forces were better able to accomplish their primary mission of interdiction. Indeed, comparison of totals from 1968 with 1967 shows an understandable decline in fixed targets destroyed or damaged after the bombing restrictions became effective. In two types of targets, however, this pattern does not hold true. Throughout 1967, plus the first three months of 1968, 7,095 LOCs were reported interdicted (destroyed) or damaged; in the next six months of 1968, there were 5,203 claimed in the lower Route Packages alone. The same trend holds true for vehicles: between January 1967 and March 1968, there were 7,222 motor vehicles destroyed or damaged; April through September 1968 strike reports totaled 5,933.<sup>26/</sup>

One of the reasons for this proportional increase in interdiction success came from what the 388th TFW Commander called a "major change" in strike force tactics.<sup>27/</sup> "Instead of entire strike forces attacking one target, single flights of two to four F-105s were fraggged against target areas in RP-I usually under the control of forward air controllers."<sup>28/</sup> Whenever possible, jet MISTY

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FACs (F-100Fs) from Phu Cat provided near realtime target information.

Concerned about the possible option of returning to the high-threat areas, however, commanders desired that crews maintain proficiency in optimum strike force tactics. One of these commanders said: <sup>29/</sup>

*"This Wing is in complete agreement with the necessity for 7AF to schedule forces of Pack VI composition into the lower Route Packs on a frequent basis. The ability to plan, coordinate and execute with a Package VI strike force has still to be learned or experienced by almost 50 pct of our F-105 crews."*

Initially scheduled to be flown every 14 days, <sup>30/</sup> these Alpha Day strikes (as they came to be called) not only gave new crews some of the experience they lacked, but provided the U.S. with two other subsidiary benefits as well. First, such tactics let the NVN intelligence system know that U.S. forces were prepared to resume bombing the Hanoi/Haiphong region, and second (perhaps more immediately productive), Alpha Day strikes were sometimes fraggged against NVN defense positions.

In late September, for instance, two flights of the 555th TFS F-4s joined other aircraft from other bases to form a strike force and, with IRON HAND support, dropped all their ordnance on a typical one pass, Route Package VI strike. Their mission was AAA suppression at Xuan Son. <sup>31/</sup>

The ordnance the strike aircraft used remained basically the same, with two significant exceptions. With the bombing pause, the 388th TFW sharply cut its expenditures of SHRIKES, firing only 17 in three months as opposed to 209 during the period from January to March 1968. <sup>32/</sup> The radar emissions were just

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not there to fire at.

More important was the introduction late in May of a stand-off weapon with the code name PAVEWAY capable of being used against visually acquired targets which were not emitting radar signals. Four F-4Ds from Ubon, Thailand, were specially configured to carry the new laser-guided bomb, and by the end of June, the initial evaluation was declared complete with an overall PAVEWAY CEP of 30 feet.<sup>33/</sup> For delivery, PAVEWAY required two aircraft, one to "spot light" the target with its laser beam, the other to actually drop the bomb. When released, the bomb guidance kit kept the bomb on target by interpreting reflected signals<sup>34/</sup> and issuing course correction commands to the gas-operated control fins.

(Fig. 6.)

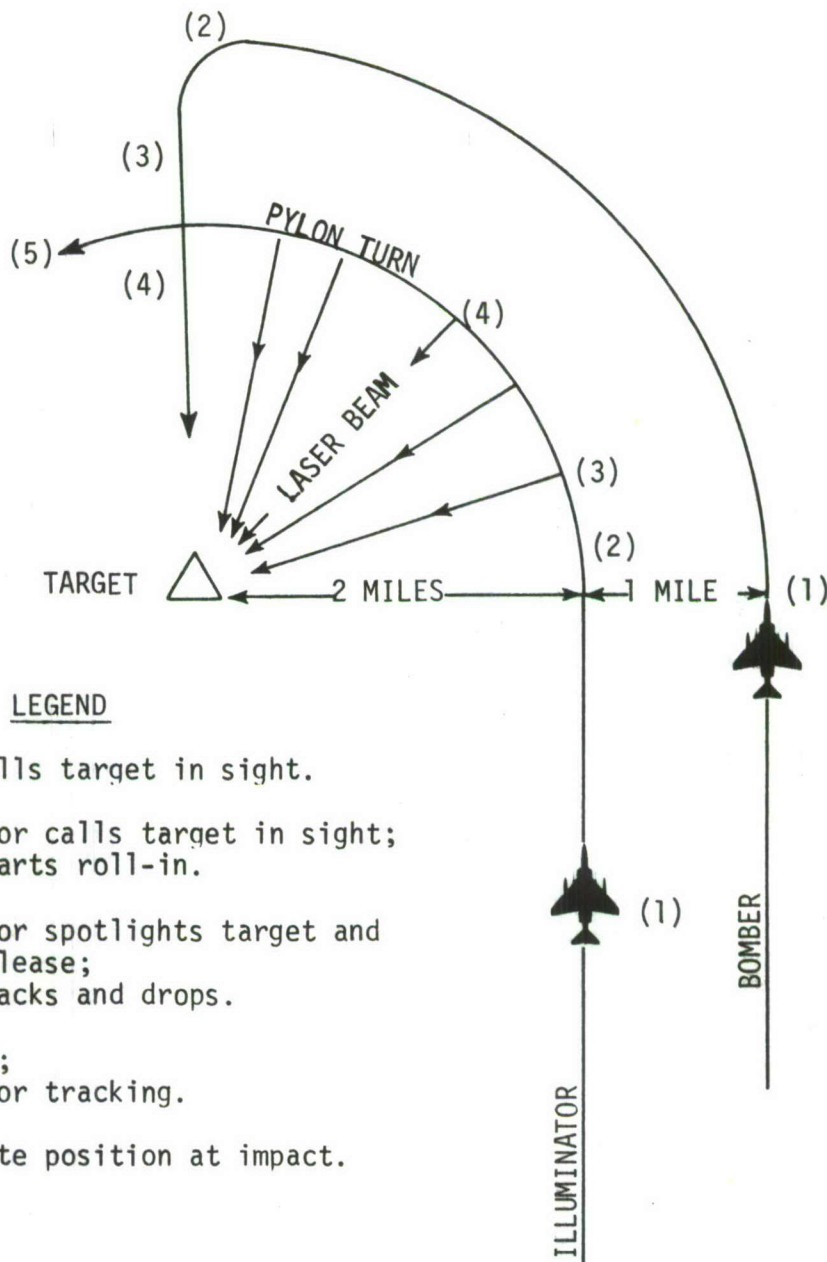
#### Operation THOR

Of all the operations which represent the changed attitude toward targeting, suppressing, and eliminating the SAM/AAA threat during this final phase of the air war in the North, Operation THOR, conducted from 1 - 7 July, is the best example. "A combined air, artillery, and naval gunfire operation against enemy offensive forces and positions in the southeastern portion of RP I," THOR<sup>35/</sup> achieved the following results:

	<u>ORDNANCE</u> (TONS)	<u>USAF</u> <u>7AF</u>	<u>USAF</u> <u>B-52</u>	<u>USN</u>	<u>USMC</u>	<u>TOTAL</u>
		1,450	5,156	784	973	8,363
<u>BDA</u>						
Sec Exp		40	122	4	11	177
Sec Fires		131	0	4	17	152

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LEGEND

- (1) Bomber calls target in sight.
- (2) Illuminator calls target in sight; bomber starts roll-in.
- (3) Illuminator spotlights target and clears release; bomber tracks and drops.
- (4) Bomb away; illuminator tracking.
- (5) Approximate position at impact.

**PAVEWAY  
BASIC DELIVERY TACTIC**

FIGURE 6

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	<u>USAF</u> <u>7AF</u>	<u>USAF</u> <u>B-52</u>	<u>USN</u>	<u>USMC</u>	<u>TOTAL</u>
<u>BDA</u>					
Arty Dest	2	96	0	0	126*
Arty Dam	0	2	0	0	18*
AAA Pos Dest	23	309	5	0	399*
AAA Dam	6	31	0	0	37

Many of the reasons for the notable success in NVN air/ground defense suppression have been touched upon; however, one interesting trend remains to be documented.

In 1966, the relationship between Route Packages I and VIA, with regard to AAA reaction versus sorties flown, was as follows: RP I - 17%; RP VIA - 70%. In 1967, the profile did not change appreciably: RP I - 18%; RP VIA - 70%. During the first three months of 1968, due to bad weather, both areas were quieter: RP I - 14%; RP VIA - 30%.

With the April bombing restriction, the situation changed in Route Package I, and for a while it seemed as if CINCPACAF's warning of the year before were about to come true.

\* Includes 28 artillery destroyed, 16 damaged, 62 AAA destroyed. Recon was unable to determine service causing destruction.

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AVERAGE REACTION RATE OF AAA-RPI  
APRIL - OCTOBER 1968

36/

April	20%
May	33%
June	35%
July	31%
August	29%
September	21%
October	18%

Forty-one percent, the highest reaction rate per sortie, occurred during the week of 15 June 1968. A few preceding weeks averaged close to this figure, but after mid-June, the number of reactions steadily declined. This was testimony to the growing fear and respect NVN defense crews had for the suppressive tactics finally used by U.S. aircraft toward the end of the air war in the North.

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## CHAPTER V

### CONCLUSION

The U.S. approach to suppression of the NVN air and ground defenses featured harassment and pressure, but pressure which stopped short of total destruction. As a result, the North Vietnamese were permitted to build and maintain a significantly effective defensive complex. Effective, that is, until the bombing halt of April 1968. The results before and after the bombing halt show the effects of fighting an air war in two different ways.

Changes in tactics in Route Package I (and to a lesser extent in RPs II, III, and IV) after 1 April were not substantive. The targeting restrictions and the policy of measured escalation prevented the U.S. forces from achieving the same results in the northern Route Packages.

Three months after the bombing restrictions went into effect, a 7AF Tactics Conference met at Korat RTAFB, Thailand. A few of the proposed tactics revisions were: <sup>1/</sup>

*"Recommend that the strike force packages for initial strikes be composed of an IRON HAND flight preceding the strike force, a flak suppression flight, three strike flights, three MIG CAP flights, and a STANDARD ARM flight.*

*"The strike force would ingress in a formation and along routing similar to the strikes used previously; however, at a point approximately 40 - 60 NM from 'bull's eye' the strike force package would disperse to two-three targets located around the periphery of the high-threat area .... This maneuver would be used for the first few strikes. Advantages of this concept are as follows:*

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*"It would avoid the stereotyped pattern of attack routing previously used.*

*"It would allow targeting of airfields, such as Yen Bai, to roll-back the MIG operating areas and similar extended threat areas."*

The changed tactics which admit the need for increased strike force protection are apparent. MIG CAP flights alone equal the number of strike flights, a logical progression from that noted much later by 7AF Force Improvement Plan for FY 72: "Just prior to the 1 April bombing halt, over 40 percent of the fighter effort in RPs V and VI was devoted to MIG CAP/Escort, as compared to 25 percent six months prior."<sup>2/</sup> Assuming, however, that enemy defenses will remain formidable, the plan cautions that "separate forces hitting many targets separated by time and distance permit the enemy to concentrate AAA, SAMs, and MIGs on smaller units and overpower them. Therefore...the present mass fighter tactics will carry forward into the near future."<sup>3/</sup>

If any single word characterizes the air campaign against the North, it would be "flexibility." Had the U.S. Air Force sent wave upon wave of aircraft over Hanoi and Haiphong without adapting its ingress and protective tactics, the attrition would have been similar to the Ploesti and Schweinfurt raids. USAF could not have repeated such tactics on a daily basis; attrition would have been even greater than it was.

It can be seen that the ingenious defensive tactics devised by NVN (LEAD/SAM sites, MIG/SAM/AAA integration, mixed AAA/AW fire, barrage SAM, MIG hit-and-run tactics, and above all, mobility), were effectively negated only when the U.S. Air Force was permitted to do what it had learned best how to do: destroy the ability of an enemy to make war, annihilate his defensive systems.

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## GLOSSARY

AAA	Antiaircraft Artillery
AAOB	Antiaircraft Order of Battle
AECM	Active Electronic Countermeasure
AGL	Above Ground Level
AOB	Air Order of Battle
Arty	Artillery
AW	Automatic Weapons
BDA	Bomb Damage Assessment
CAP	Combat Air Patrol
CEP	Circular Error Probable
ChiCom	Chinese Communist
CINCPAC	Commander-in-Chief, Pacific Command
CINCPACAF	Commander-in-Chief, Pacific Air Forces
CINCPACFLT	Commander-in-Chief, Pacific Fleet
COMUSMACV	Commander, U.S. Military Assistance Command, Vietnam
DMZ	Demilitarized Zone
ECCM	Electronic Counter-Countermeasures
ECM	Electronic Countermeasure
ELINT	Electronic Intelligence
EOB	Electronic Order of Battle
EW	Electronic Warfare
GCI	Ground-Controlled Intercept
IH	IRON HAND
JCS	Joint Chiefs of Staff
LOC	Line of Communications
MHz	Mega Hertz
mm	millimeter
MONEVAL	Monthly Evaluation
NM	Nautical Mile
NVN	North Vietnam
OpOrd	Operations Order
POL	Petroleum, Oil, and Lubricants

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RHAW	Radar Homing and Warning
ROE	Rules of Engagement
RP	Route Package
RT	ROLLING THUNDER
RTAFB	Royal Thai Air Force Base
SAM	Surface-to-Air Missile
SEA	Southeast Asia
TFS	Tactical Fighter Squadron
TFW	Tactical Fighter Wing
TOT	Time Over Target
TRW	Tactical Reconnaissance Wing
UHF	Ultra High Frequency
USMC	United States Marine Corps
USN	United States Navy